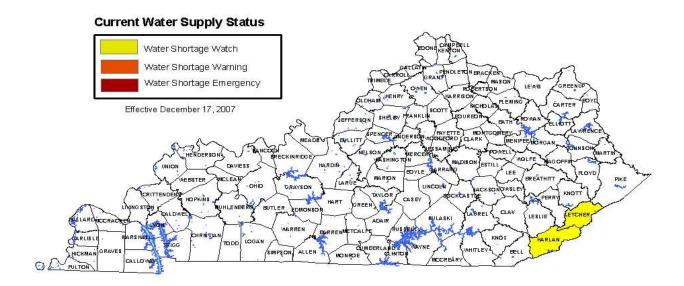
Drought

The Kentucky Division of Water continuously monitors hydrologic conditions throughout the state, including precipitation, streamflows, lake elevations and various drought indices. This information is used to detect emerging drought conditions, to identify the locations and severity of drought and to provide timely and appropriate public notification.

Kentucky Drought Monitoring Center



UPDATE Nov. 13, 2007 – WATER SHORTAGE WATCHES, WARNINGS LIFTED FOR 19 COUNTIES. (To view press release please click here.)

Water Shortage Notification System Explained

Water Shortage Response Status of known public water systems reported to the Division of Water.

Statewide Summary of Drought Development



Conditions across the western two-thirds of the state have improved in recent weeks reducing drought concerns. Streamflows generally are within a normal range for this time of year and many small water supply reservoirs have rebounded. Cooler temperatures reduced evapo-transpiration (the water returned to the atmosphere through the combined actions of evaporation and plant growth) and the chance for normal winter rainfall will continue to help.

The large precipitation deficit that remains over southeastern Kentucky keeps the east under severe drought. The immediacy of the drought was reduced somewhat by October precipitation, but the threat to some water supplies still exists. The Division of Water will continue to monitor the situation. Please remember that it is important for all Kentuckians to comply as fully as possible with any requests made by their water suppliers to help conserve water.

Useful Drought Indicators

PRECIPITATION

For the year, precipitation deficits for Kentucky range from 67 percent of normal in the Eastern climatic division to 89 percent of normal in the Central division. The current 30-day precipitation totals in the Western, Central, Bluegrass and Eastern climatic divisions averaged 174, 242, 200 and 112 percent of normal, respectively.

STREAMFLOWS

Many streamflows across the state, where they are not being supplemented by lake releases, are again in decline. The effects of the October precipitation have peaked and flows are now moving towards baseflow conditions.

LAKE ELEVATIONS

Several small water supply lakes have been returned to near-normal elevations from recent rains, but many remain well below-normal due to the overall precipitation deficit. Most lakes under the control of the Huntington District, Louisville District and Nashville District of the U.S. Army Corps of Engineers are currently being draw-down to winter pool elevation. Releases from Corps of Engineers reservoirs are important to the status of many Kentucky rivers as sources of supply for drinking water, assimilation of wastewater discharges, water quality and aquatic habitat. These rivers include the Green, Barren, Rough, Nolin, Kentucky, Salt, Licking and Big Sandy rivers.

DROUGHT INDICES

Assessing the severity of a drought is made easier with the use of drought indices that combine various source information into a single representative value of drought severity. The Palmer Drought Severity Index uses data for precipitation, temperature and evapo-transpiration to calculate a number that can be compared across different times and locations. This index was developed in the 1960s in Kansas and Nebraska but has since become a part of drought monitoring in a majority of the United States. The Palmer Drought Severity Index is updated weekly on Monday afternoons.

The <u>Drought Monitor</u> represents a comprehensive assessment of several factors that contribute to the development of drought or that indicate the severity and potential persistence of drought. The Drought Monitor is updated weekly on Thursday mornings.

Updated Nov 7, 2007

The Palmer Drought Severity Index and the Drought Monitor maintain significant improvement in the West, Central and Bluegrass climatic divisions and portions of the East climatic division. In the East division, the extreme southeast has shown little improvement.

The Palmer Drought Severity Index issued on Nov. 5, 2007, places the West, Central and Bluegrass climatic divisions in near normal status (-0.04, 0.19 and -0.79, respectively). The East climatic division (-3.60) remains in Severe Palmer Drought. All values are preliminary.

It is important to note that the Palmer Drought Severity Index is used as a general index of drought over large geographic areas defined by the four climatic divisions of Kentucky. Rainfall that affects one part of a climatic division may substantially improve drought conditions on a county or multi-county level but have little or no impact on the regional average conditions defined by the Palmer Index.

***Updated Nov. 7, 2007 ***

An area in southeastern Kentucky designated as in exceptional drought by the U.S. Drought Monitor continues to shrink. This area includes Bell and Harlan counties. Layered on this area are bands characterizing drought conditions from extreme to none. The East climatic division remains the worst (severe to exceptional). The eastern Bluegrass and southern Central divisions are designated as abnormally dry to moderate drought. All areas west of this are considered normal.

As a drought indicator, the Drought Monitor is not limited to four large climatic divisions, rather it incorporates the Palmer Index as just one of several indicators of drought development in a given area. These other indicators include more short-term components including the Crop Moisture Index, Standardized Precipitation Index and weekly streamflow percentiles. The Palmer Drought Severity Index and the Drought Monitor should be considered in combination with more localized data such as rainfall, streamflows, groundwater levels and climatic outlooks to form an accurate assessment of drought severity in a given location.

Drought Monitoring

Drought is a natural and recurring feature of our climate that can be considered a "severe" weather event much like a tornado, a flood or a hurricane. However, there are a few key differences that distinguish drought from other weather events that make it difficult to detect, track and respond to drought.

Part of the difficulty in detecting drought is in the lack of an obvious onset of drought conditions. A drought develops slowly and can appear to mimic a normal spell of dry weather in the summer, a time of the year when dry weather is accepted and expected. Short-term rainfall shortages create problems for agricultural crops, livestock, urban landscapes and other activities that depend on stored soil moisture between rainfall events. We are accustomed to dealing with short-term dry spells in part because there is an expectation that rainfall is just around the corner. However, when rainfall shortages persist for weeks or months at a time, activities that depend on long-term storage of water will be adversely impacted as well. Droughts in Kentucky can have serious negative consequences for drinking water supplies, energy production, commercial and industrial operations, recreation and aquatic habitat.

The negative impacts of drought cannot be avoided but there are ways to reduce them to a manageable level. All water suppliers in the commonwealth should have a water shortage response plan to guide both the supplier and customer during a drought event. It is important for customers to listen to their water suppliers and be ready to take necessary actions to prevent a water shortage problem from developing. This is critical to a successful outcome because the only way to effectively manage the source of water supply is to first manage the demand for water.

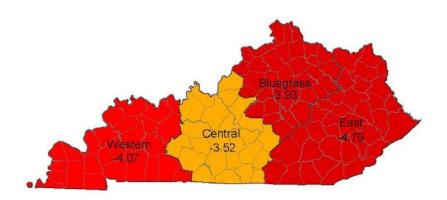
There is no easy method for determining when a dry spell has become a drought, how long a drought will persist or how intense a drought may become. However, by closely tracking certain sources of information, referred to as drought indicators, it is possible to detect potential drought development early enough to allow at least some lead-time for notification and initiation of drought response preparations at the local level. The Division of Water monitors for the potential development of drought in Kentucky by tracking precipitation, streamflows, lake levels, groundwater and water supplies. There are also several tools that are useful in assessing the severity of a "dry spell" and the potential impacts to agriculture, forest fires, water supplies and other vulnerabilities to drought. These tools include the Palmer Drought Severity Index, the Drought Monitor, the Standardized Precipitation Index and several others.

The Drought Monitoring pages will be updated on a weekly basis to provide timely information and assessments of current drought conditions in Kentucky. There will also be numerous links to other resources and drought information pages from various state and federal agencies.

***Updated Oct. 4, 2007 ***

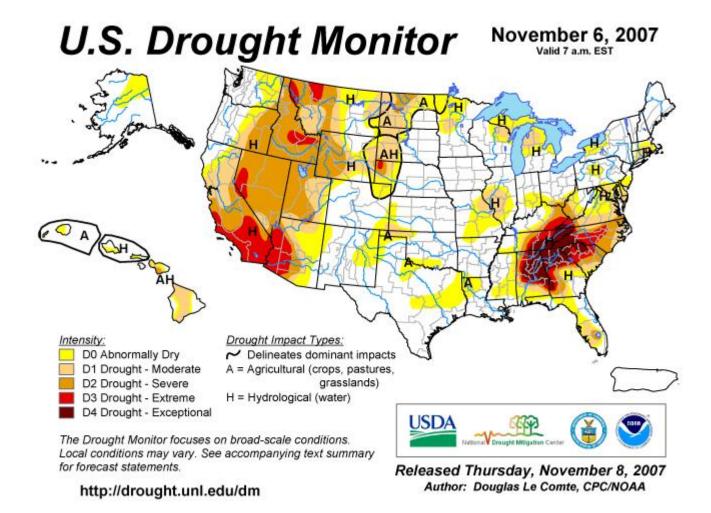
Palmer Drought Severity Index The Palmer Drought Severity Index (PDSI) is compiled weekly by the Central Region Climate Prediction Center (National Centers for Environmental Prediction, National Weather Service and National Oceanic and Atmosphere Administration) and provided on the University of Kentucky Agricultural Weather Center's Web site. This index is useful for placing a developing drought into context with past droughts and serves as a measure of current conditions. The index also provides a standardized assessment of developing drought conditions that can be compared between different areas of the state or even between different states.

PDSI values can be categorized as follows:

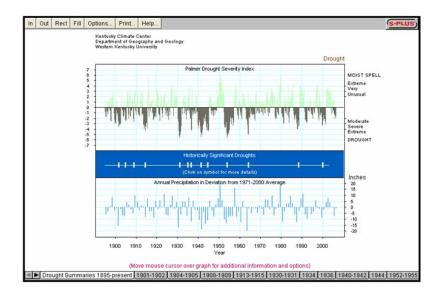


0 to -0.99 = near normal
 -1.00 to -1.99 = mild drought
 -2.00 to -2.99 = moderate drought
 -3.00 to -3.99 = severe drought
 -4.00 and below = extreme drought

The Drought Monitor



Tracking drought blends science and art. No single definition of drought works for all circumstances, so people rely on drought indices to detect and measure droughts. But no single index works under all circumstances, either. The Drought Monitor is a synthesis of multiple indices, outlooks and news accounts, that represents a consensus of federal and academic scientists. A detailed description of the parameters used to create the Drought Monitor can be found here.



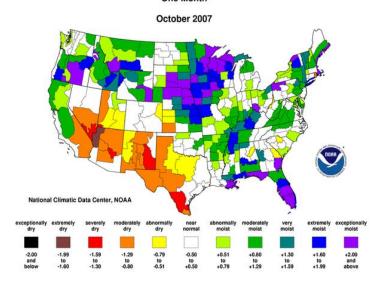
Interactive graphs displaying drought indices since 1895 for Kentucky's four climate divisions. Users can identify and explore the development of historically significant droughts.

Examining the past can be a useful tool in interpreting the significance of a developing drought situation. Comparisons of the current drought to the historical record provide a frame of reference for evaluating how serious the current drought has become, and how it might develop in the coming months. One of the best tools to evaluate past droughts is found at the Kentucky Climate Center at Western Kentucky University. Click on the figure at the left to visit this site and learn more about the history of drought in Kentucky.

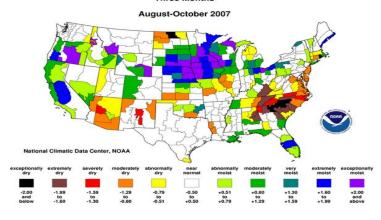
The Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is a way of measuring drought that is different from the PDSI. Like the PDSI, this index is negative for drought and positive for wet conditions. But the SPI is a probability index that considers only precipitation, while Palmer's indices are water balance indices that consider water supply (precipitation), demand (evapotranspiration) and loss (runoff).

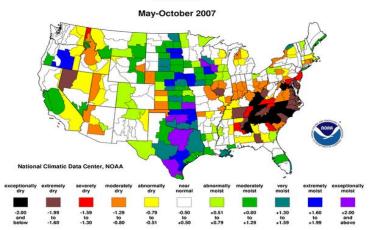
Standardized Precipitation Index One Month



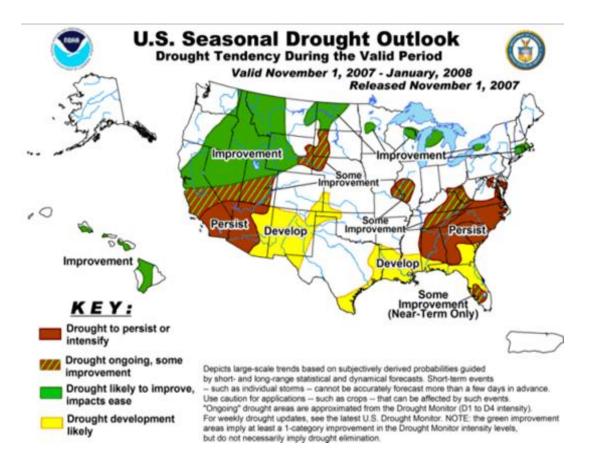
Standardized Precipitation Index Three Months



Standardized Precipitation Index Six Months



U.S. Seasonal Drought Outlook



The Climate Predication Center issues the U.S. Seasonal Drought Outlook each month in conjunction with the release of the long-lead temperature and precipitation outlooks.

Weather and Climate

PRECIPITATION

The Division of Water monitors a network of 24 daily climate-reporting stations to track developing shortages of precipitation. For the year, precipitation deficits for Kentucky range from 67 percent of normal in the Eastern climatic division to 89 percent of normal in the Central division.



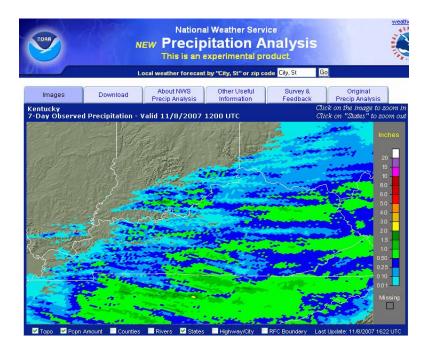
(Click on images to enlarge)

Precipitation: Data for the previous 30/60/90-day period and the Water Year Beginning October 01, 2006

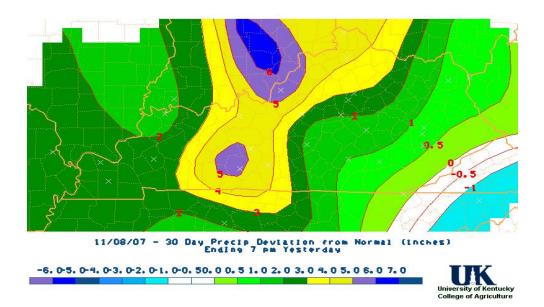
	Water Year		30/60/90 Day Total		Precipitation and Departure			From Normal
Station	Precipitation Totals (inches)	Departure From Normal (inches)	30 Day Total (inches)	30 Day Departure (inches)	60 Day Total (inches)	60 Day Departure (inches)	90 Day Total (inches)	90 Day Departure (inches)
Henderson	32.27	1.35	1.29	-3.28	5.88	-2.85	9.26	-4.06
Paducah	33.68	-1.04	2.32	-2.63	5.75	-4.04	8.72	-5.87
Princeton	30.11	-6.18	2.05	-2.88	5.96	-3.64	8.32	-6.07
Mayfield	27.58	-10.52	0.60	-4.16	3.85	-5.93	5.75	-9.21
Louisville	30.34	0.04	1.19	-3.26	6.33	-2.39	9.31	-3.87
Bardstown	27.05	-2.41	0.61	-3.84	5.24	-3.16	8.62	-3.98
Hardinsburg	29.47	-4.05	1.24	-3.48	5.51	-3.58	7.82	-5.70
Campbellsville	29.07	-6.24	1.69	-3.51	7.53	-2.45	11.86	-2.88
Nolin Lake	30.33	-5.12	3.35	-1.90	8.12	-1.79	10.49	-3.60
Glasgow	27.72	-8.33	1.38	-3.63	6.30	-3.32	9.49	-4.98
Bowling Green	25.25	-10.23	2.58	-2.26	6.60	-2.63	7.55	-6.52
Covington	24.60	-3.06	0.92	-3.31	3.46	-4.58	6.07	-6.02
Williamstown	32.10	2.93	1.80	-2.53	5.99	-2.51	12.43	-0.56
Spindletop	21.72	-7.66	1.30	-3.07	4.69	-3.63	7.17	-5.35
Lexington	26.89	-2.48	2.22	-2.14	5.96	-2.35	8.75	-3.76
Dix Dam	24.47	-6.36	1.26	-3.38	5.62	-3.30	9.45	-3.70
Berea	24.11	-6.60	1.49	-3.28	5.69	-3.41	9.30	-3.93
Grayson	24.78	-2.65	1.82	-2.06	5.34	-2.71	8.35	-3.19
Jackson	21.76	-9.63	1.88	-2.52	4.27	-4.27	5.67	-7.06
Quicksand	20.38	-11.12	1.87	-2.65	4.21	-4.45	5.60	-7.24
Buckhom Lake	18.13	-12.27	0.63	-3.51	3.84	-4.09	6.00	-6.04
London	21.97	-9.18	0.96	-3.29	5.88	-2.32	6.66	-5.77
Somerset	26.75	-7.78	1.30	-3.80	5.31	-4.23	7.63	-6.30
Cumberland Gap	20.80	-14.40	0.30	-4.44	4.62	-4.30	7.75	-5.93

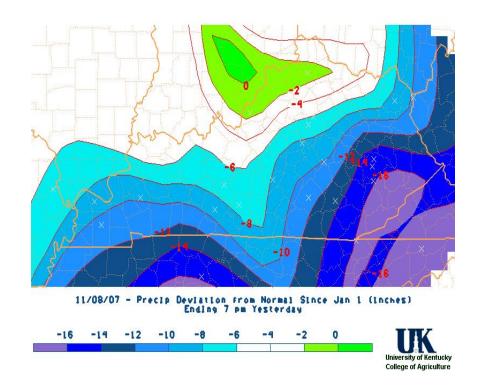
Climatic Division	Normal Precip. Water Year	Normal Precip. Calendar Year	Percent of Normal Precipitation					
			Water Year	Calendar Year	30 Day	60 Day	90 Day	
Western (1)	2.81	40.16	196	79	174	129	92	
Central (2)	2.67	40.56	276	89	242	148	116	
Bluegrass (3)	251	36.83	225	86	200	129	97	
Eastern (4)	2.70	38.89	126	67	112	83	67	

During a three-day event (Oct. 23 through Oct. 25), widespread rainfall with significant short-term totals swept across the state. It was an unusual occurrence as such precipitation this time of year without a tropical storm or hurricane influence is quite rare. On Oct. 23 alone, areas in the Central and Bluegrass climatic divisions received up to 6 inches. For the entire event, precipitation totals in southeastern Kentucky only reached 1.5 to 2 inches. The current 30-day precipitation totals in the Western, Central, Bluegrass and Eastern climatic divisions averaged 174, 242, 200 and 112 percent of normal, respectively.

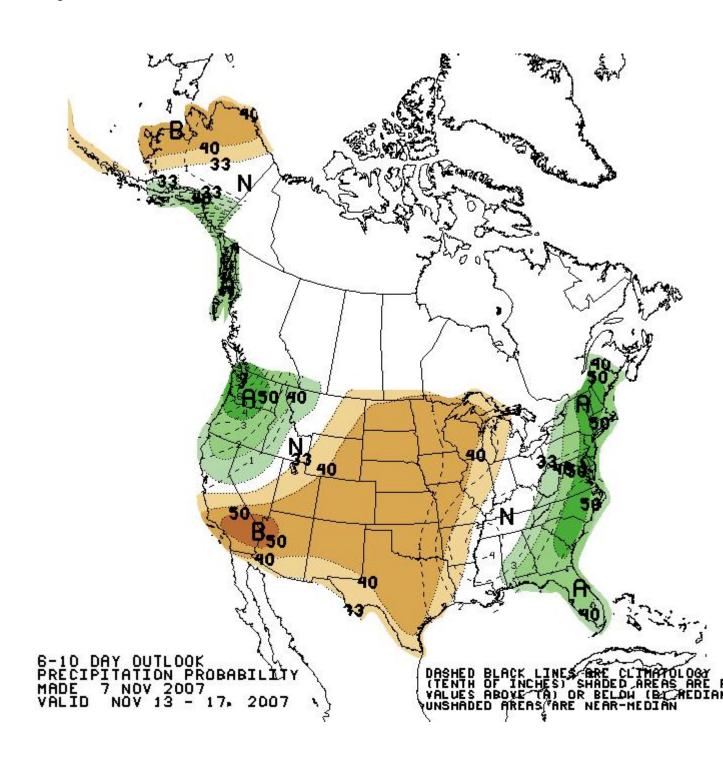


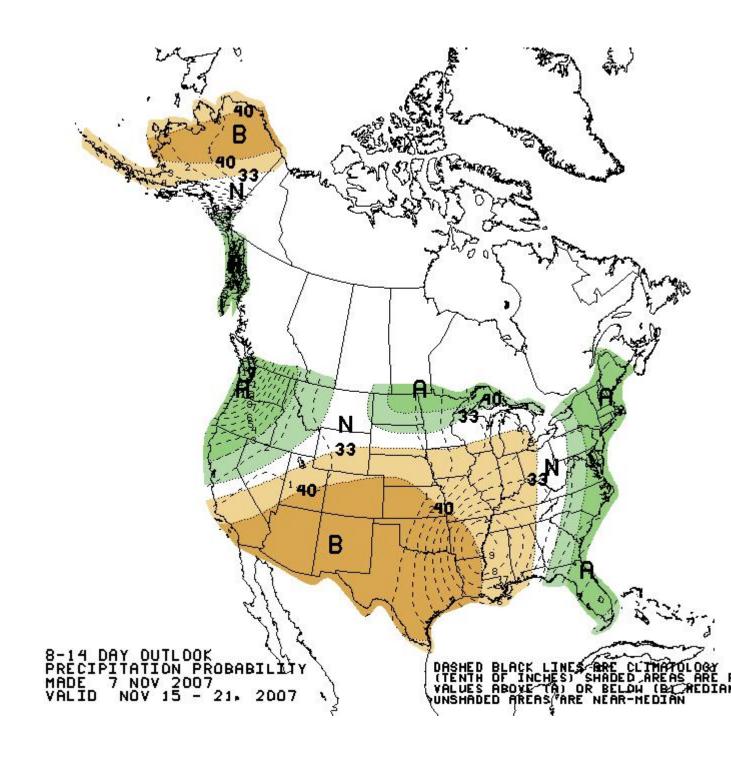
ATTENTION: One of the best tools to assess the amount and distribution of precipitation in Kentucky is the National Weather Service's <u>Precipitation Analysis Product</u>. Data can be displayed for many different time frames and can be selected to show not only the amounts, but also the deficits and percentages of normal for each time frame.





The annual precipitation deficit has improved for most of the state but remains significant. The largest deficit remains in southeastern Kentucky. Deficits in the headwaters of the Kentucky, Licking, Cumberland and Big Sandy river basins are still 12 to 18 inches for the year. The 10- to 20-inch precipitation deficit that had built in parts of the Purchase area of the west is now in the range of 8 to 12 inches. Precipitation ranges from near normal in the northern portions of the Central and Bluegrass climatic divisions to a deficit of 8 to 12 inches in the south.





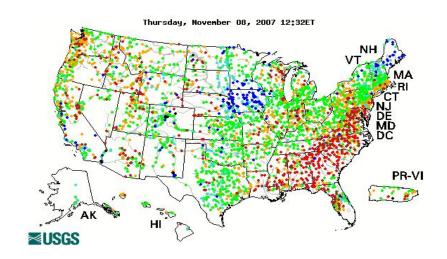
The six- to 10-day short-term outlook from the Climate Prediction Center indicates a below-normal chance for precipitation across the state. The eight- to 14-day outlook calls for above-normal precipitation in the east and equal chances for below-normal, normal and above-normal rainfall for the rest of the state. One to three month outlooks from the Climate Prediction Center indicate equal chances for below-normal, normal and above-normal rainfall for Kentucky.

Hydrology

STREAMFLOWS

The <u>U.S. Geological Survey</u> maintains a <u>real-time stream gauging network</u> that monitors flows in all major river basins in Kentucky. Measurements of streamflow are a very good indicator of the longer-term hydrologic impacts of drought. During the developing stages of drought, streamflows provide valuable information on the severity and regional extent of emerging problems. Streamflow data is evaluated relative to the long-term record to determine drought intensity and identify potential problems associated with water shortages. Once a drought has matured, streamflow measurements are critical at many locations where water withdrawals have the potential to cause adverse environmental impacts to streams.





Updated Nov. 7, 2007

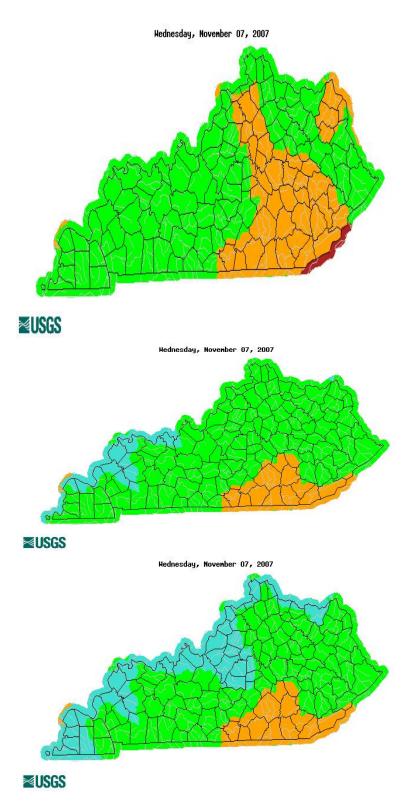
Many streamflows across the state, where they are not being supplemented by lake releases, are again in decline. The effects of the October precipitation have peaked and flows are now moving towards baseflow conditions. About 35 percent of the real-time stream gauging network is currently below a normal range for this time of year (less than a 25 percentile flow) and close to 15 percent of the gauges are now classified as much below-normal (less than a 10 percentile flow).

Weekly and Monthly Streamflow

For a slightly longer-term perspective of streamflow conditions across Kentucky, the United States Geological Survey computes average flows for the previous seven, 14 and 28 days. The resulting average streamflow values are categorized relative to the long-term record and assigned levels of severity based on the frequency that similar magnitudes of low-flow have occurred in the past. By averaging over a period of several days to several weeks, the values on the map are more indicative of longer-term conditions than daily average or real-time streamflow measurements.



Seven-Day Average Streamflow 14-Day Average Streamflow 28-Day Average Streamflow



The 28-day average streamflow indicates that flows are within a normal to abovenormal range for the majority of the state. The only exceptions are the Upper Cumberland and Tennessee River basins where the 28-day average flows are belownormal. The 14- day average streamflow is similar, but the Tennessee River basin is

within a normal range. A seven-day average streamflow map shows less variation. The Upper Cumberland and Little Sandy river basins are below- normal, the Tennessee River basin is significantly below-normal and the rest of the state is within a normal range.

Lakes and Reservoirs U.S. Army Corps of Engineers Projects

Another useful measure of the impact that drought is having on a region is the status of area lakes and reservoirs. The Division of Water monitors data from 12 projects operated by the U.S. Army Corps of Engineers (USACE) from three USACE districts: Louisville, Huntington and Nashville. These projects strive to maintain reservoirs at pool levels consistent with the operating guidelines as part of the larger mission of flood control and navigation in the Ohio and Mississippi rivers. Beginning in April, the releases from the reservoirs are managed to allow filling to the "normal summer pool elevation." Similarly, between the months of September and November most projects begin releases to bring down surface elevation to "winter pool." This process generally creates a large increase in streamflow when it may be needed the most. Significant precipitation deficits in the basin above the reservoir can adversely affect the attainment of normal summer pool elevation and the volume of water released during winter draw-down. This, in turn, may result in low flows in the river below the project when releases from the reservoir are reduced to the minimum needed for water quality and aquatic habitat.

By examining the data for "current pool elevation" and "current outflow," valuable information about the status of large headwater areas above the USACE reservoirs can be obtained.



United States Army Corps of Engineer Reservoir Information Updated Nov. 7, 2007

November 5, 2	2007			
Basin	Project	Current Outflow (cfs)	Normal Summer Pool Elevation (ft)	Current Pool Elevation (ft)
Little Sandy	Grayson	44.5	645	640.8
	Dewey	151.7	650	649.4
	Fishtrap	144.8	757	743.9
	Yatesville	168.1	630	627.4
Big Sandy	Paintsville	13.6	709	708.6
Licking	Cave Run	508.0	730	726.5
	Carr Creek	40.0	1027	1021.2
Kentucky	Buckhorn	135.0	782	773.9
Salt	Taylorsville	50.0	547	547.1
	Green River	49.0	675	674.0
	Nolin	2581.0	515	505.0
	Barren River	1773.0	552	544.8
Green	Rough River	26.0	495	490.5

Currently, most reservoir levels are being reduced through draw-down to winter pool elevation. Recent widespread precipitation events helped bring many projects back up in elevation allowing operating guidelines to be followed. Rough River Lake was dropped to winter pool elevation in September to allow for repairs to the stilling basin.

Small Lakes and Water Supply Reservoirs

The Division of Water will monitor selected small water supply reservoirs when conditions indicate that water supplies may be threatened by persistent drought. Several small water-supply lakes have been returned to near-normal elevations from recent rains, but many remain well below normal due to the overall precipitation deficit. Customer demand has forced a number of these water systems to call for conservation measures.